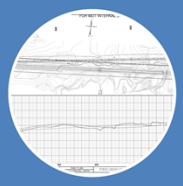
MONTANA
MDT
DEPARTMENT OF TRANSPORTATION

# Geotechnical Features

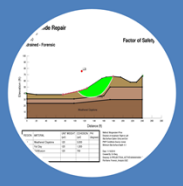
D.J. Berg, P.E. - Glendive District Geotechnical Manager

# Geotechnical Design Process



Geotechnical Features

Site Investigation

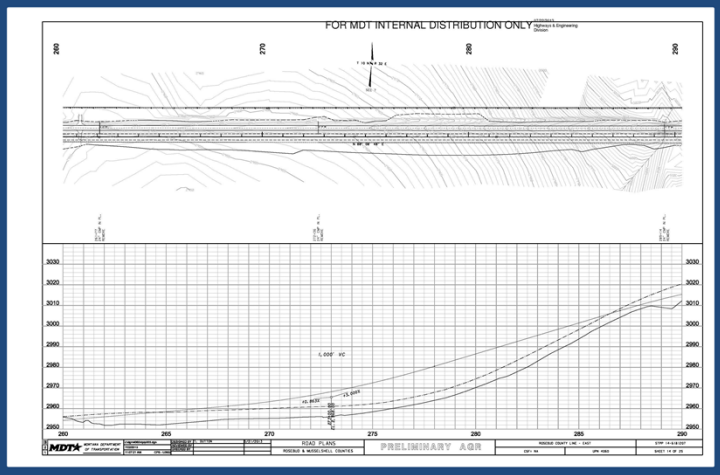


Geotechnical Design

Construction

# What is a Geotechnical Feature?

Identified by thinking critically about design and construction of roadway elements.



# What is a Geotechnical Feature?

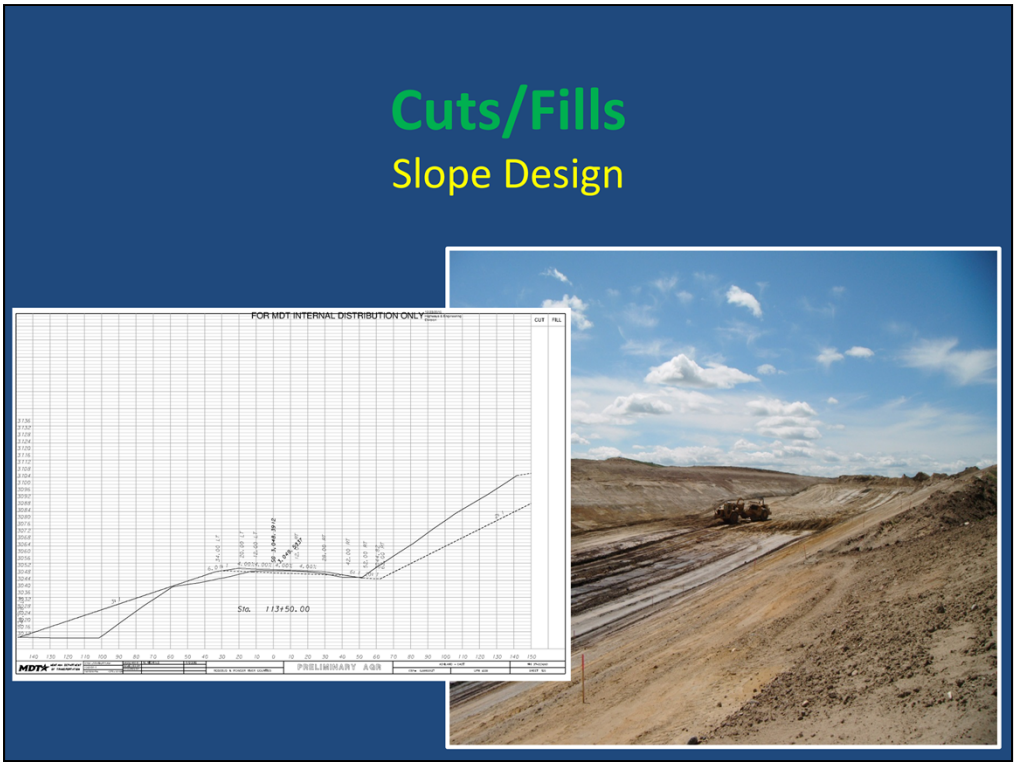
Mostly related to earthwork and foundations.

# What is a Geotechnical Feature?

Sometimes include unusual problems.

# Major Geotechnical Features

- Cuts/Fills
- Embankment Over Soft Ground
- Rock Slopes
- Retaining Structures
- Pipes
- Structure Foundations
- Landslide Corrections




Primarily driven my Slope Stability analysis, short-term and long-term

# Cuts/Fills

## Subgrade

**G. Digout.** In areas of digout, excavate the full road width to a depth as shown in the contract or as directed by the Project Manager. Excavate parallel to the finish grade, daylighting to the left and right slopes. Slope the ends of the digout no steeper than 4H:1V. Dispose of the excavated material to the satisfaction of the Project Manager.

Provide special borrow for digout replacement material consisting of a well-graded sand and gravel, free of organic and other deleterious material, meeting the AASHTO M 145 requirements for A-1-a group classification, with 100% passing the 2-inch (50 mm) sieve and a maximum of 8% passing the No. 200 (0.075 mm) sieve. The material may consist of up to 50% millings, uniformly blended. Crusher fines and reject material may be used if the requirements in Table 701-22 are met.

Provide stabilization geotextile that meets the requirements of Subsection 716.03 for Stabilization geotextile.

Place stabilization geotextile over the bottom and sides of the excavated digout area in conformance with Subsection 622.03. Extend the geotextile up the side walls of the excavation for the full height of the exposed subgrade soils.

Place the initial lift of special borrow over the geotextile in accordance with Subsection 622.03.2.

Repair any geotextile damaged during construction in accordance with the Manufacturer's recommendations or as directed by the Project Manager at Contractor expense.

# Cuts/Fills

## Unsuitable Material

SPECIAL PROVISIONS **Error! Reference source not found.**

1. COAL WASTE

A. Description. Remove and dispose of any coal found within the roadway excavation.

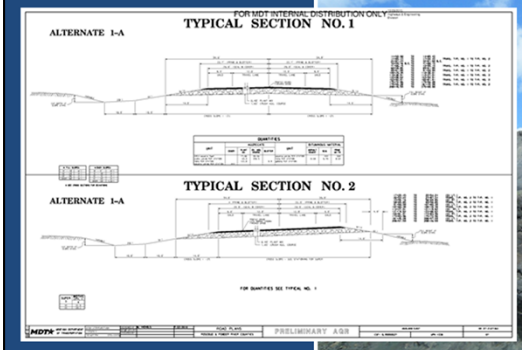
B. Construction Requirements. Waste all coal encountered in excavation on construction fill slopes or suitable location approved by the Project Manager. Cover with a minimum of 1 ft of excavated material including placement of topsoil. If coal is encountered at subgrade in cut sections, excavate to a minimum depth of 2 ft below subgrade elevation and full width of planned pavement section. Backfill with Special Borrow in accordance with Section 203.03.3.

C. Measurement and Payment. Include the cost to waste coal as outlined above including haul and placement, in the unit bid price for unclassified excavation.

Digouts, Subexcavation, Coal Waste

# Cuts/Fills

## Constructability


FOR MDT INTERNAL DISTRIBUTION ONLY

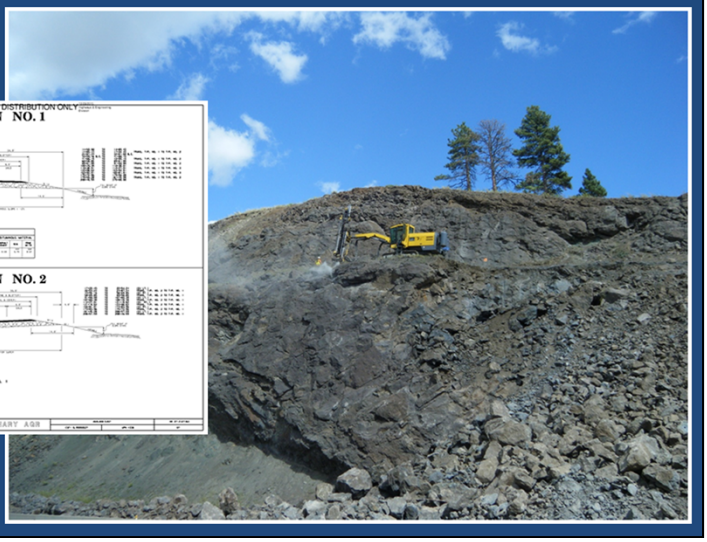
TYPICAL SECTION NO. 1

ALTERNATE 1-A

TYPICAL SECTION NO. 2

ALTERNATE 1-A

PRELIMINARY AGR

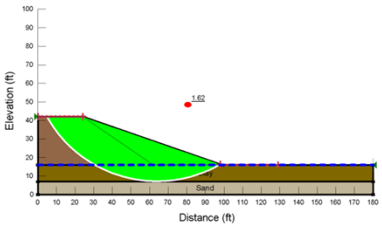


# Embankments Over Soft Ground

## Stability (Bearing Capacity)

**Culvert S of Opheim**
*UPN 8883000*
Station 468+00
**Short-term Analysis**

**Factor of Safety: 1.62**



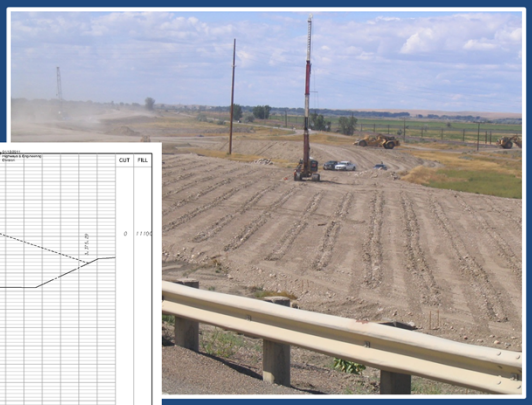

| REGION | MATERIAL | UNIT WEIGHT (pcf) | COHESION (psf) | PHI (degrees) |
|---|---|---|---|---|
| 1 | Sand | 125 | 0 | 34 |
| 2 | Clay | 120 | 670 | |
| 3 | Embankment | 120 | 0 | 30 |
| | | | | |
| | | | | |

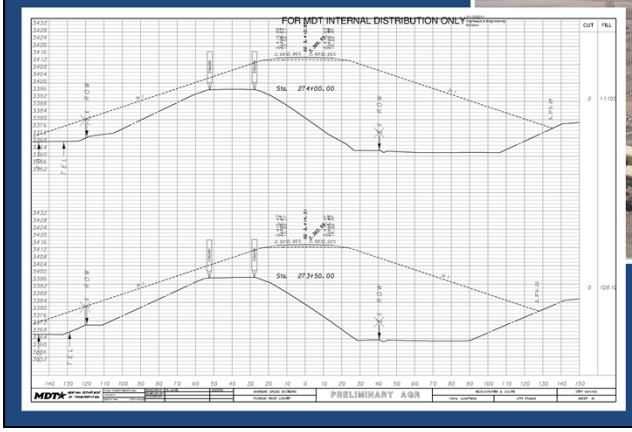
Method: Morgenstern-F
Direction of movement:
Slip Surface Option: En
PWP Conditions Sourc
Minimum Slip Surface E

Date: 10/25/2016
Created By: DJ Berg
Directory: S:\PROJECT
File Name: STA_468+0

# Embankments Over Soft Ground

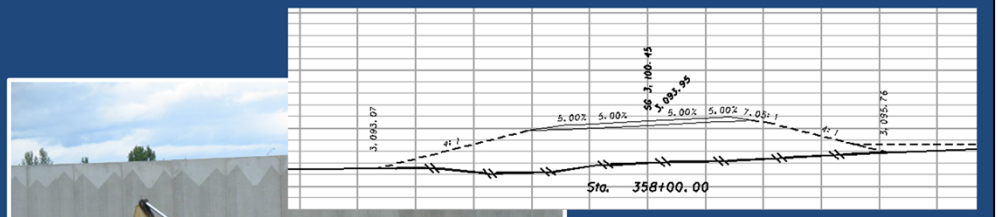
## Settlement





# Embankments Over Soft Ground

## Constructability

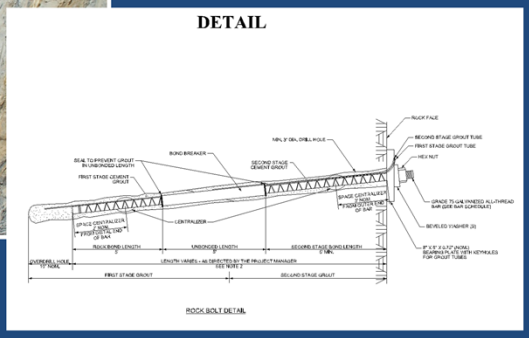



# Rock Slopes

## Blasting

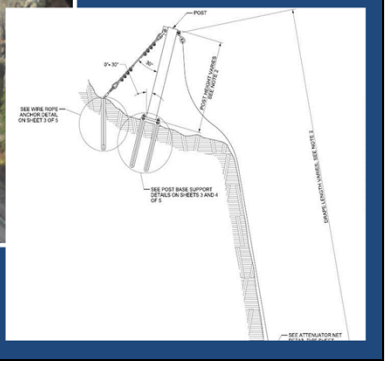
# Rock Slopes

## Stability



# Rock Slopes

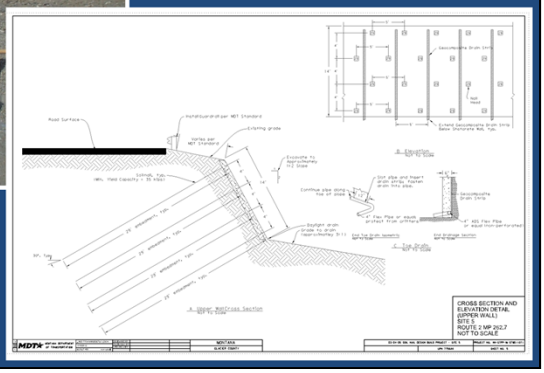
## Protection


Barrier, scaling.

# Retaining Structures

## Types




MSE, Soil Nail, Gabion, Gravity, Cantilever


Stability of wall (bearing capacity, sliding, global stability)

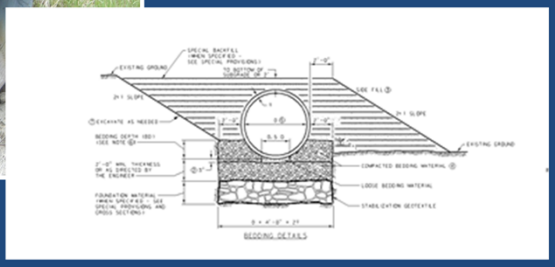
Drainage components

# Retaining Structures

## Constructability

# Pipes

## Settlement



# Pipes

## Constructability


SPECIAL PROVISIONS

CONTRACT NO. Click here to

1. CULVERT FOUNDATION TREATMENT (REVISED 12-11-15)

A. Description. Prior to culvert placement, construct the culvert foundation, consisting of culvert excavation, geotextile placement, and foundation material placeme locations shown in the plans or as directed by the Project Manager.

B. Materials.

1) Provide Stabilization Geotextile meeting the requirements of Section 71(

2) Provide Culvert Foundation Material with a maximum of 15% passing th sieve in addition to the requirements of Subsection 701.04.2.

C. Construction.

1) Excavate a zone as shown elsewhere in the Contract and 2.0 ft below th of the planned bedding elevation.

2) Place geotextile as shown elsewhere in the Contract or as directed by th Manager. Overlap any adjoining edges of the geotextile a minimum of 3.0 ft with the ec the upgrade sheet over the edge of the downgrade sheet.

3) Place the first 16 inches of Foundation Material over the geotextile with compaction effort necessary to create a stable base, with the least amount of equipmer possible, and otherwise in accordance with Subsection 622.03.

4) Do not use vibratory, studded, or sheepsfoot rollers on the first 16 inche

5) Place subsequent lifts in accordance with Subsection 622.03.

D. Method of Measurement.

1) Culvert Foundation Material is measured in accordance with Subsection 603.04.

2) Geotextile is measured in accordance with Subsection 622.04

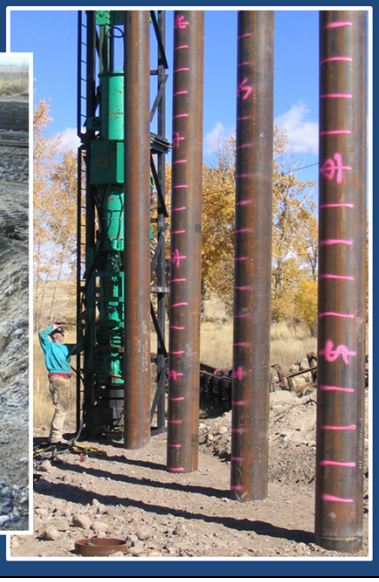
E. Basis of Payment. Payment is full compensation for all labor, tools, equipment and other incidentals necessary to complete the work in accordance with the specifications and as directed by the Project Manager.

1) Culvert Foundation Material is paid in accordance with Subsection 603.05

2) Geotextile is paid in accordance with Subsection 622.05.

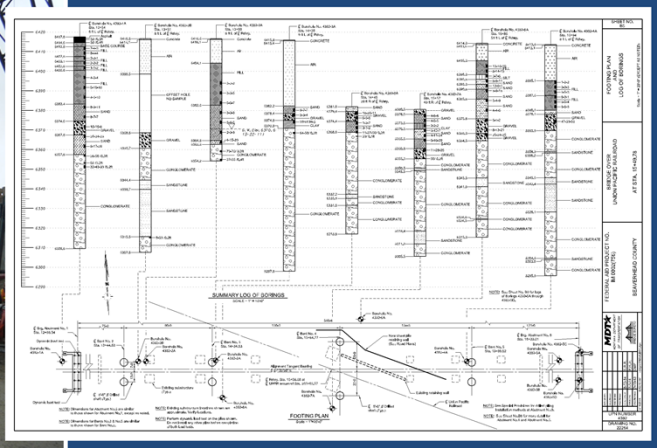
# Structure Foundations

## Type



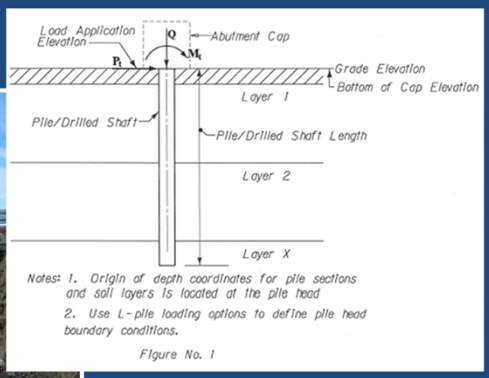
# Structure Foundations

## Size/Depth



# Structure Foundations

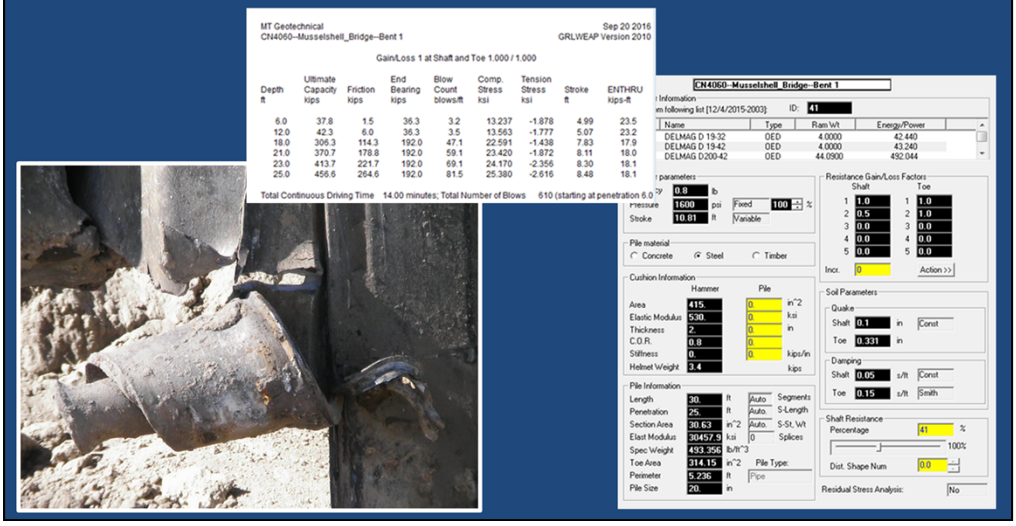
## Other Considerations




Lateral loads (Ice, Seismic, Impact), liquefaction, lateral spread

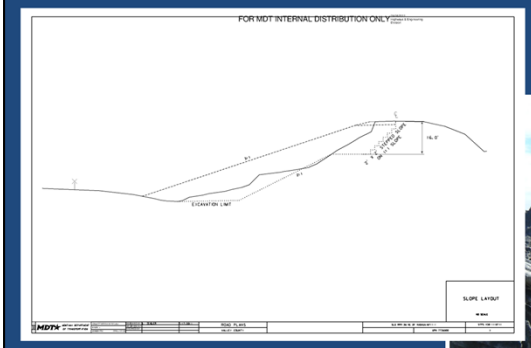
# Structure Foundations

## Constructability



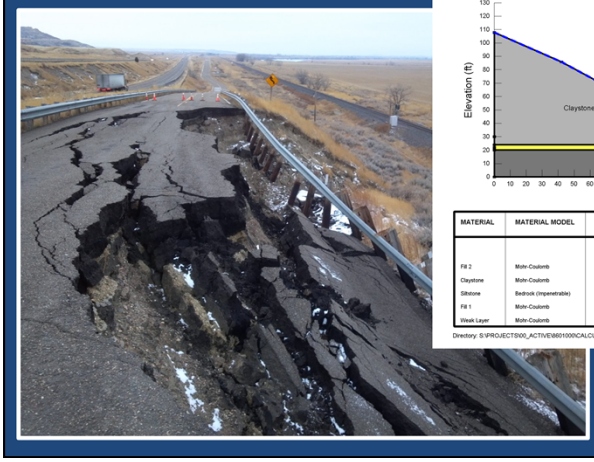
# Landslide Corrections

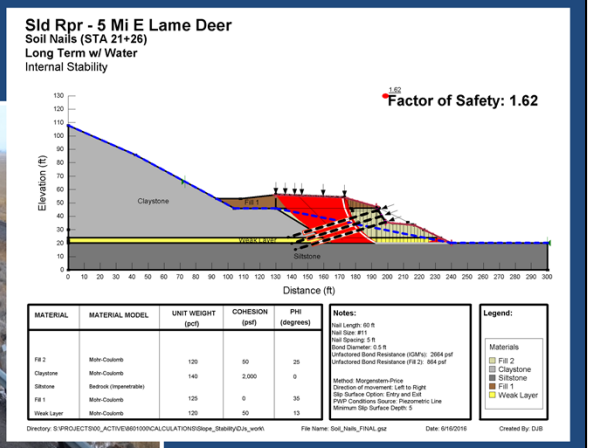
## Repair Strategies




# Landslide Corrections

## Analysis






Forensic, Mitigation

## Unusual Geotechnical Features

- Subsurface Voids
- Expansive Soils
- Collapsible Soils
- Frost Heave
- Forensic Evaluations

# Questions